Survival Factors
Airbag Safety Study
October 8, 2009

Location:	Boyd, TX
Aircraft Type:	Cessna 172 SP
Accident Date:	July 14, 2009
Accident Time:	1750 CDT
Accident Number:	N2446F, CEN09LA442
Airbag Equipped:	Yes

Group Members:
NTSB Group Chairman:
Courtney Liedler

Additional Members:
Steve Miller – Cessna
Tom Barth – AmSafe
Tom Latson - NTSB

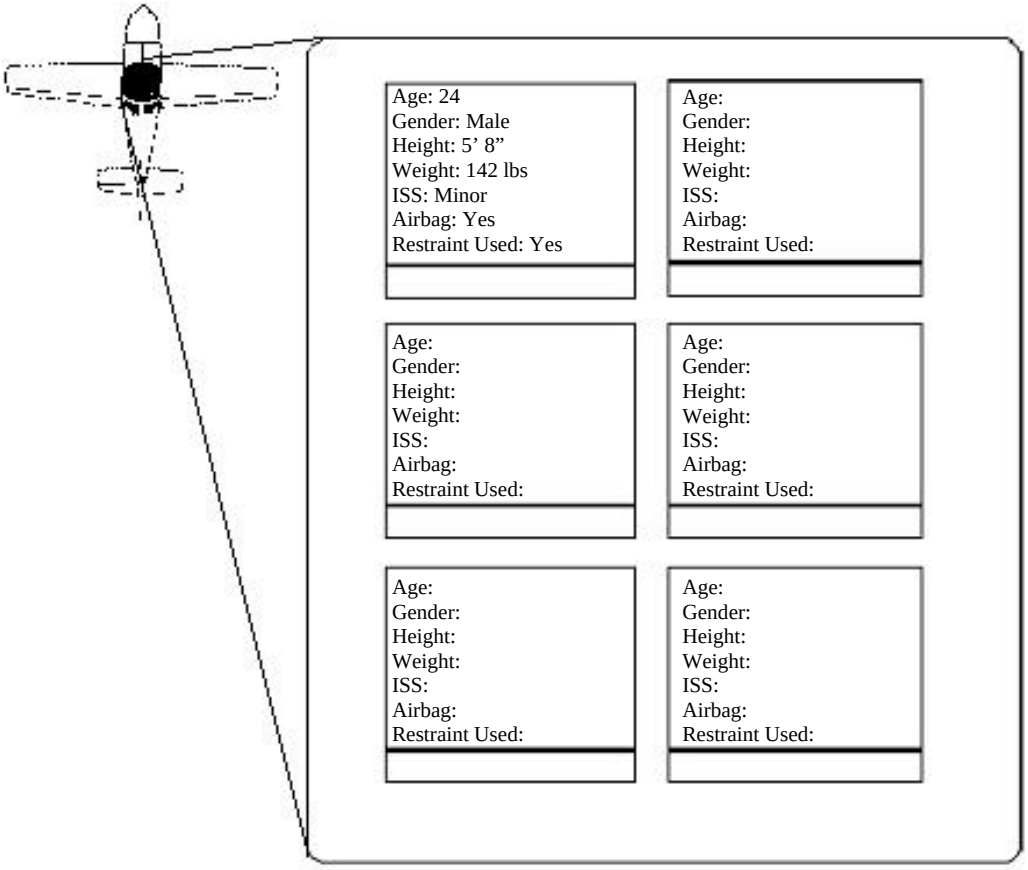
Summary

On July 14, 2009, at 1746 central daylight time, N2446F, a single-engine Cessna 172S was substantially damaged during a forced landing following a loss of engine power two miles west of Boyd, Texas. The solo student pilot sustained minor injuries. The flight was being conducted under the provisions of Title 14 Code of Federal Regulations Part 91 without a flight plan. The local flight originated from Fort Worth Meacham International Airport (KFTW), Fort Worth, Texas. Visual meteorological conditions prevailed at the time of the accident.

Weather at the time was reported at KFTW, approximately 20 miles to the southeast as clear skies, winds from 170 degrees at 13 knots gusting to 22 knots, temperature of 102 degrees Fahrenheit, and dew point of 58 degrees Fahrenheit.

An on scene investigation was conducted by an inspector from the Federal Aviation Administration. The inspector indicated that the airplane came to rest in an upright position in a pasture after hitting a cattle fence, becoming airborne again, hitting a tree, and then hitting a man made embankment of a stock water pond. The 2006 Cessna was equipped with factory installed airbags as part of the seatbelt restraint system. The airbags deployed. The airplane was been recovered to a secure location in Lancaster, Texas for further investigation.

Seating Chart:



Documentation:

The airplane remained largely intact (figures 1 and 2). The firewall was buckled. The engine mounts were intact and the mounting tubes were not bent or cracked, with the exception of the right lower mount tube that was bent slightly to the right. The forward fuselage firewall and engine was displaced downward approximately 30 degrees -- from the instrument panel forward -- and approximately 5 degrees to the right.

The nose gear was displaced aft, and was embedded into the fuselage (figures 3 and 4). It had ruptured the floor between the two forward seats and intruded into the cockpit about 3 inches.

The instrument panel was intact, with the exception of some cracking of the paneling between the throttle and primer levers. The trim wheel and fuel selector valves were damaged and deformed inward, toward the left side foot well area. The rudder pedals and flooring below the pedals were bent and displaced (figure 5).

The roof over the cabin exhibited compression wrinkles, which were more pronounced on the right side of the roof. The windscreen was not damaged (except at corners from

wing removal). The left visor was fractured, and hair remnants were found on the door molding screw, 2nd back from front (figures 6 and 7).

Left side of the aircraft

The front left nose section (immediately forward of door frame) had vertically separated. All three of the windscreen flashing rivets had sheared. Five additional rivets sheared downward along the rivet line located forward of the door frame; and the skin continued to fracture downward along six rivets. The crack then propagates aft. The left main gear strut had fractured at mount, and the gear strut moved freely. The tire was inflated and the hub was intact.

The bottom aft corner of the left door/frame was dented, with no corresponding dents on the airframe (dent occurred from door falling off). Oil canning[1] was found on bottom and top aft portion of door frame. No witness marks or damage was noted on inside of door.

The left wing had a compression wrinkle from a 45-degree angle, extending across mid-point, consistent with a downward vertical load. No buckling was found at the root of the wing. The top side of the wing had minor buckling at the flap junction.

Right side of the aircraft

The front right section (immediately forward of front door frame) had vertically separated. One of the three windscreen flashing rivets had sheared and five additional rivets sheared downward along the rivet line forward of the door. The crack continued downward and aft toward the door frame. There were compression wrinkles forward of the strut mount. The right main gear strut was intact at mount and had bent aft. The tire and hub had fractured completely off. The right main gear was displaced upward to a position level with the fuselage attach point and aft approximately 8 inches.

Buckling of the right rear door frame was observed. Oil canning was found on the on door frame and on the door itself, at the latch. There were compression wrinkles in the roof area above the right front seat.

The right wing exhibited no visible deformation from fuel load (i.e., no bulge on wing tank). Small dents were observed on the leading edge of the right wing at locations 48”, 83”, 86.5”, 88” in from root. Compression wrinkles on underside of right wing at the center of the first panel, outboard of fuel tank. Black marks (rubber and grease) were observed forward of flap at 28” and 44” out from root. Another grease mark was found 52” out from the wing root.

[1] Oil canning is a perceived waviness across the flat areas of thin-gauge sheet metal panels.

Figure 1: On-scene photograph showing the damage to the aircraft.

Figure 2: On-scene photograph showing the damage to pilot's side.


Figure 3 and 4: Photographs of nose wheel intrusion taken during airbag exam.

Figure 5: Photograph of left side (pilots) foot well taken during airbag exam.

Figures 6 and 7: Photograph of broken visor and hair remnants in doorframe molding screw, respectively.

Seats

The front seats were measured and their dimensions are documented on an exemplar photo in figure 8. The left seat (figure 9) was occupied by the pilot. The seat was intact. The seat position locking pins were fully engaged in second hole from front. Damage was observed to right front wheel assembly from impact with seat rail. The seat pan was displaced approximately 0.25” at the front bend line and 1.40” at the aft bend line (compared to the undamaged right seat measurements)

The right seat was not occupied; however it was inspected for comparison to left seat. The seat position locking pins were fully engaged in the eighth hole from the front.

Both sets of seat rails were intact and attached to the floorboard. The right seat’s seat rail appeared unremarkable. The left seat’s left inboard rail was bent upward at the forward end approximately 1” from the nose wheel penetration. The left seat’s outboard rail appeared unremarkable.

Figure 8: Relative dimensions of the Cessna seats (photograph is of exemplar Cirrus seats).

Figure 9: Photograph taken during wreckage exam of condition and position of left seat.

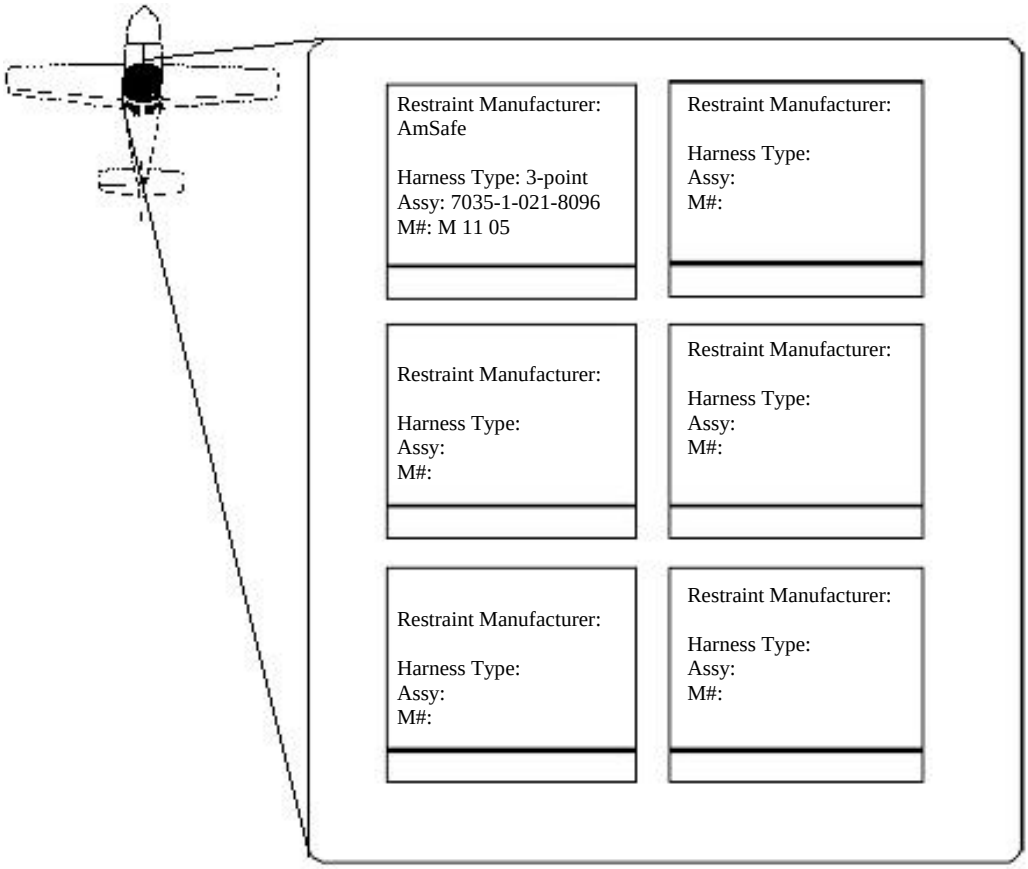
Restraints:

Condition of Restraints:

The accident airplane had three-point restraints. The front left seat restraint buckle loadbar was found 29” from the anchor inside the cabin. A witness mark was observed at that location (figure 10). The connector tongue showed no marks outside normal wear. The seatbelt retractor functioned properly.

The right seat was not occupied; however, the restraint was inspected and no evidence of loading was observed and the seatbelt retractor functioned properly.

Restraint Numbers:



Inertial reel part number A/N 50884-401-8096, date of manufacture A-09-05

Figure 10: Photograph of witness mark on front left restraint.

Airbags:

The front left seat airbag system was found deployed, intact and still connected. The system was photographed and then AmSafe staff disconnected the inflator (figure 11). The inflator part number was 508794-401. No bag seam tears were noted on the left airbag (figure 12). There was some tearing of the airbag cover and some stitching that had pulled out at mouth of bag (figure 13), which is normal for loaded bag. The airbag width was 17" and height was 30".

Instrument Panel Side:

The vent hole on the instrument panel side of the airbag (figure 14) was slightly squared at two locations, about 3 threads. There was a greenish vertical mark starting at the bottom of the bag, extending upward 7.5". The greenish mark was located 7.5" from outboard edge and 6.75" from inboard edge of the airbag. A black mark 1.125" wide was noted, at 6" from outboard edge and 7 from inboard edge. There was a black/grey scuff mark near center of bag. Another black/grey scuff mark was observed near the vent hole, 3" long, 7.5" from outboard edge and 8.75" from inboard edge of the airbag.

Occupant Side:

There was a blood spot found on the occupant side of the left airbag (figures 15 and 16). The blood spot was 7.5" from the top of the bag, 8" from inboard edge of bag and 9.5" from outboard edge. A black mark 4.5' long was observed, beginning 4' from inboard edge and ending 6.5' from inboard edge. A crescent shaped black mark at center of bag 2.25" long, starting 8.5" from inboard edge and ending 6.5" from inboard edge.

Figure 11: Photograph showing left side airbag system remained connected to inflator

Figure 12: Photograph of tearing of airbag cover, and stitching pulled out at mouth of bag

Figure 13: Photograph of instrument panel side of left (pilot's) airbag.

Figure 14: Photograph of vent hole on instrument panel side of left (pilot's) airbag.

Figure 15: Photograph of occupant side of left (pilot's) airbag

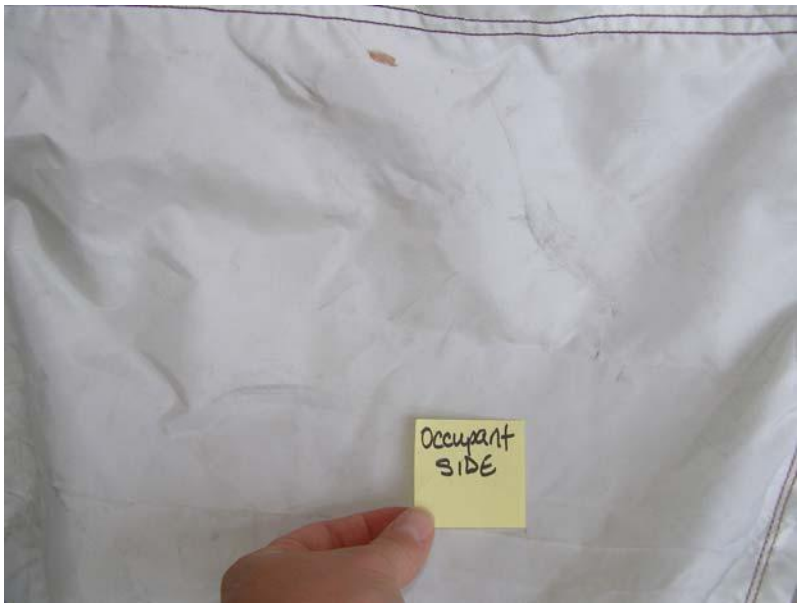


Figure 16: Photograph of blood and scuffing on occupant side of left (pilot's) airbag

Medical/Autopsy Information:

The below occupant injury data was obtained from emergency room medical records. The occupant was treated at Wise Regional Health System in Decatur, Texas on July 14, 2009.

Occupant Location	Gender	Age	Height	Weight	Description Of Injuries	Injury Classification
1st Row, Left	M	24	5'10"	142lbs	Laceration (3cm) to left side of head (staples), sprained right ankle, contusion on right heel, back strain	Minor